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"Occlusion" by dictionary definition refers to the act of closure or the state of being closed. In dentistry the word "occlusion" has come to mean the static intercusp relationship of the teeth and also the act of closing the teeth together. This chapter deals primarily with "the act of closure" and how the closing strokes of mastication and other jaw closures are influenced by the anterior teeth (anterior guidance). Anterior guidance refers to both incisal and cuspal guidance. The role of the anterior teeth in the learning process of mastication will also be considered.

Balanced occlusion for natural dentitions has been found to be unphysiological (Stallard and Stuart, 1963),¹ and "unbalanced" or anteriorguided occlusion is biologically better (D'Amico, 1958.² Standlee and Caputo, 1979³). Three mechanical guiding factors can prevent posterior teeth from making harmful eccentric contacts. They are the right and left condylar articulations and the appropriate guiding teeth. We are concerned in this chapter with the potentials of the anterior teeth as guiding factors for preventing harmful posterior tooth contacts. These potentials include both mechanical and neuromuscular factors. Since "unbalanced" occlusion is desirable for natural dentitions a question which arises is, how "unbalanced" should a good natural tooth arrangement be? The term "anterior disclusion" is in common use at the present time. Although "anterior disclusion" does not appear in the dictionary the term is used to describe anterior tooth functions which separate the posterior teeth in eccentric motions of the jaws. The word "disclusion," however, is quantitatively ambiguous and can be used to mean as little as a few hundredths of a millimeter. Minimal to moderate "lift" on the anterior teeth usually disappears in a relatively short period of time, thus allowing the posterior teeth to come into eccentric contact. The term "anterior disclusion" is inadequate to describe the potential biological guiding function of the

anterior teeth. It is also confusing because it implies that bruxing movements are normal. This is evident from observing most present-day illustrations depicting lower cusps moving from centric outward to eccentric position. "Anterior disclusion" also seems to imply that only anterior teeth occlude. Perhaps the best way to "disclude" would be simply to open the mouth.

Anterior teeth have a mechanical advantage over posterior teeth because they are farther from the fulcrum. This positioning gives them better leverage to offset the closing muscles of mastication. This concept is presented diagrammatically in Figure 3-1. The mechanical advantage is apparent when one tries to "bite hard" with the front teeth as compared to biting hard with the molars. Anterior guidance on a purely mechanical basis, however, is quite limited. Because of their poor axial inclinations, the anterior teeth would no doubt be susceptible to overloading if they were protected only by their mechanical advantage (Figure 3-2). If one assumes that the periodontal structures could withstand the mechanical forces of mastication and that the cuspids were allowed continually to rub against their opposing mates during lateral chewing strokes, these teeth would no doubt be completely worn down at an early age.

The natural crown morphology of both anterior and posterior teeth develops early in life and is complete in every detail prior to tooth eruption into the oral cavity (Figure 3-3). However, the other organs and components of the mouth and related structures continue to change significantly long after the occlusal morphology of the teeth is complete. This morphology does not change except from unnatural causes such as trauma, wear, decay, chemicals, and operative and restorative procedures. Natural tooth morphology per se is not the cause of most malocclusion problems. It is the relationships of the upper teeth to the lower teeth as the jaws close (in function and nonfunction) that create the majority of problems

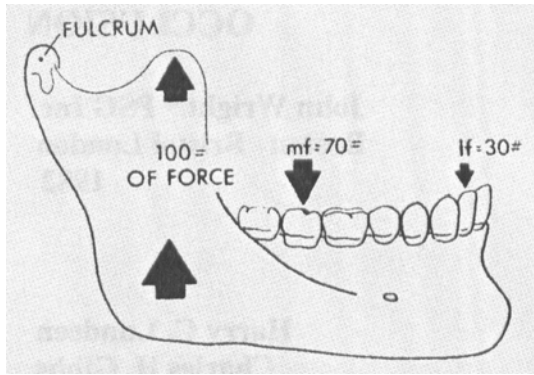


Figure 3-1 A muscle contraction of 100 lb of force (for example) could be distributed more on the posterior teeth (mf) and less force (lf) on the anterior teeth. This is because the anterior teeth are farther from the fulcrum than the posterior teeth and this gives the anterior teeth a mechanical advantage.

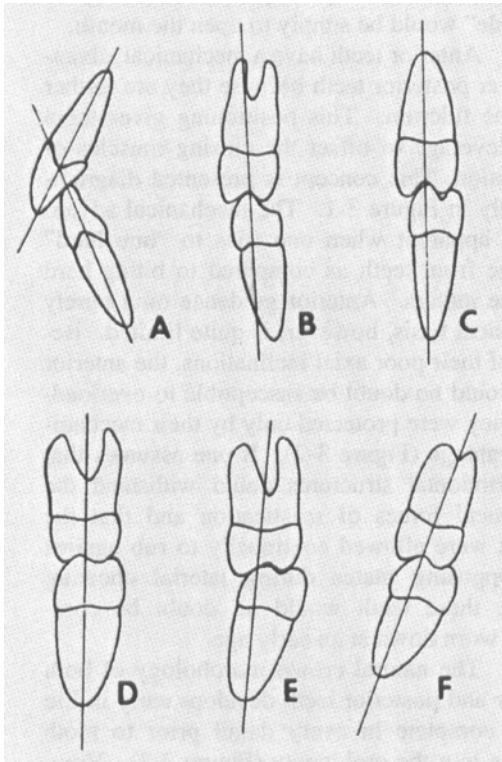


Figure 3-2 The molars and premolars are in axial alignment with their mates in the opposing arch. The anterior teeth (A) however, have poor axial relations to their mates in the opposite arch. Because of keen proprioception and strategic location, the anterior teeth are protected from over-stress when the occlusion is functioning properly.

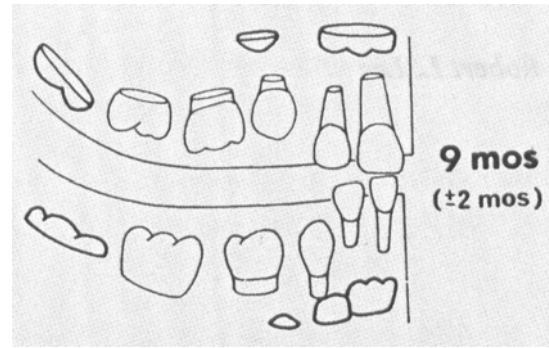


Figure 3-3 By nine months of age, the anterior teeth of the child are erupting into the oral cavity and produce early subconscious awareness of occlusion which is recorded by the central nervous system.

in occlusion. Most of these poor relationships of the teeth are due to skeletal disharmonies connected with heredity, growth and development and habits. Other bad relationships of the teeth may be caused by lost teeth and subsequent tooth drift, or even by iatrogenic causes such as high crowns and fillings or improper orthodontic treatment.

THE LEARNING PROCESS

Until recently there have been few extensive studies in mandibular neuromuscular physiology. D'Amico (1958)² published his thesis on the canine teeth. Moyers (1956)³ reported on the role of the neuromuscular mechanism and centric relation. With the improvement of instruments and methods during the last twenty years, research in neuromuscular physiology has given new insight in the study and clinical treatment of occlusal problems (Ahlgren, 1969)⁴ Jerge, 1964⁵ Kawamura, 1967⁶ and Scharer, Stallard, and Zander, 1967⁷. A better understanding of the role of the central nervous system and the *learning process* as well as of muscle physiology and proprioception makes it clear that occlusion involves more than mechanics. The muscles have no intelligence of their own and must receive all directional stimuli from the central nervous system. The central nervous system gathers and stores information from many sources, including the teeth.

Ramfjord and Ash (1971)⁸ state that with the growth of the infant and the eruption of the teeth, afferent stimuli from the receptors in the periodontal membrane influence the central nervous system and reflexly influence the position of the mandible. With the eruption of the

teeth, the process of mastication is *learned*, and learning depends upon the *cerebral cortex*. In the adult, alterations in tooth position, loss of teeth, high fillings and other influences evoke learning of new masticatory patterns. In time, these new jaw movements may contribute to dysfunctional states in components of the masticatory system which cannot adapt or compensate for the poor relationships of the teeth.

The first teeth to erupt into the child's mouth are the incisors, which establish early subconscious occlusal awareness (Figure 3-3). As the child becomes an adult the anterior proprioceptive feedback mechanism should continue to keep the central nervous system informed of how the lower teeth approach the upper teeth during the closing motions of the jaws. Perhaps the child learns to chew by trial and error much as he learns to walk or to feed himself. In addition to the periodontal pressoreceptors there are many other organs including the lips, tongue, cheeks, mucosa, skin, and muscles that are rich with proprioceptive bodies. These proprioceptors continuously monitor the position of the mandible and feed the information back to the brain. (Figure 3-4). If a person is fortunate enough to develop a good relationship of the teeth, learned reflexes develop by which the mandible functions more vertically as the lower teeth approach the upper in the final portion of the chewing strokes. In lateral chewing strokes, for example, these controlled reflexes allow the lower cuspids to approach their mates in the upper arch and then cause the mandible to swing toward the midline so the cuspids do not clash (Figure 3-5). The avoidance of clashing eccentric contacts between the upper and lower anterior teeth during mastication may be similar to the learned reflex of walking, where the feet pass very close to the floor but seldom touch it. More vertical guidance by the anterior teeth helps to prevent the upper and lower posterior teeth from colliding as the mandible moves toward centric position (Figure 3-6).

Anterior Proprioceptive Feedback

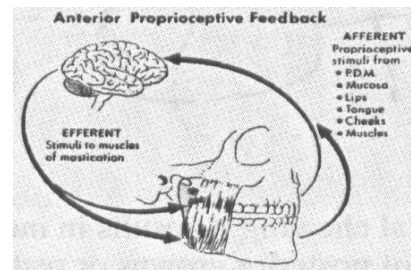
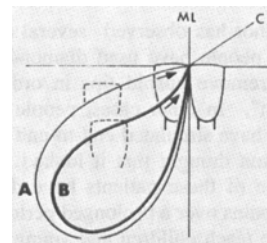


Figure 3-4 In addition to the periodontal pressoreceptors, there are many other organs including the lips, tongue, cheeks, mucosa, skin, and muscles that contain proprioceptive bodies. These proprioceptors continuously monitor the position of the mandible and feed the information back to the brain. The brain, in turn, tells the muscles how to move the mandible.

Frontal Plane

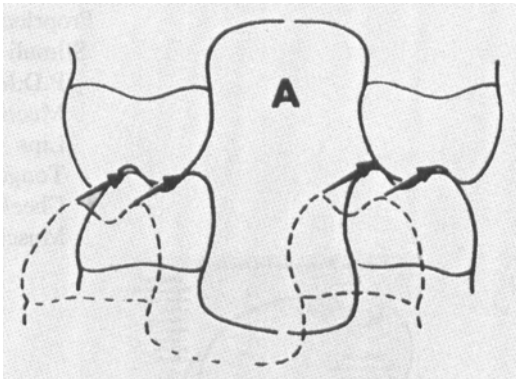
Unilateral Chewing Motion (MANDIBULAR INCISORS)

Figure 3-5 Path A illustrates a unilateral chewing stroke on a patient with worn cuspids. These patients chew in a more horizontal manner,



which results in continued wear on the teeth. Pathway B shows the effects on the lateral chewing patterns when the cuspids have normal length and position. The patient learns to function more vertically in the final portion of the chewing stroke when the cuspids are functioning properly.

HORIZONTAL CHEWING



VERTICAL CHEWING

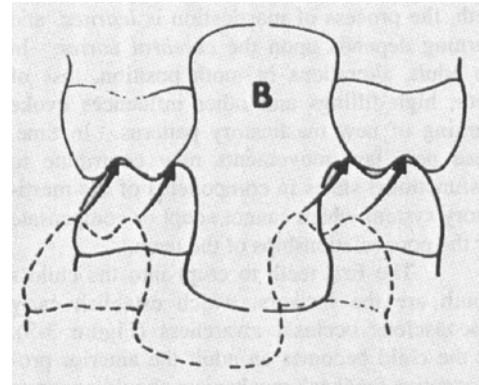


Figure 3-6 Horizontal chewing A results in increased chances of eccentric molar and premolar contacts or abnormal flattening of posterior crowns or restorations. More vertical chewing B results in less wear on the teeth and less stress on supporting tissues provided the guidance to centric position is assigned to the proper anterior teeth. More vertical chewing permits posterior crowns to retain normal occlusal morphology, which has the detailed anatomy of a young unworn dentition. Functional efficiency of pattern B is created by having well-formed cusps, fosse, ridges, and grooves. The occluding function cusps can penetrate and shred tough fibrous foods and also crush the hard brittle pieces in the fossae.

The teeth do not have to strike to stimulate the pressure sensitive receptors in the periodontal tissues. The presence of food between the teeth can be detected by pressure on the periodontal pressoreceptors and the information relayed to the brain. Kawamura has shown that the teeth most sensitive to pressure changes are the central incisors, followed by the laterals, cuspids, bicuspid, and last the molars the most insensitive (Kawamura, Nishiyama, and Funakoshi, 1967⁹).

The author has observed several cases in which young people have used diamond fingernail files to remove cuspid tips in order to have “even teeth”. In other cases, people with anterior overjets have simulated end-to-end bites because the person thought that it looked more “normal”. Some of these patients have developed myofascial pains over a prolonged period. It might be wise to teach children and young people the functions of their teeth and why they should masticate vertically. They can be taught to make conscious efforts to avoid bruxing. The training of mastication may be compared to training in proper tooth brushing, correct walking habits, or many other learned rational behavior patterns.

CENTRIC POSITION

No doubt the most important condyle-to-meniscus, arch-to-arch, tooth-to-tooth relationship in occlusion is centric relation position. Centric relation is the ending location of good chewing strokes and is a comfortable physiologic position for all people who have relatively healthy temporomandibular joints and good mandibular muscle control. Centric relation may be defined as any place along the arc of closure where the condyles are bilaterally in their most superior position and in intimate contact with the meniscus in the glenoid fossae when no lateral forces are applied. A stable centric position depends upon bones, ligaments, and muscles which are relatively free from pathology. Maintaining a stable centric position of the condyles can be better assured by having well-related anterior teeth. Centric position of the condyles in the fossae is continuously reinforced by the musculature through good vertical guidance from the anterior teeth.

One of the problems in the clinical treatment of occlusion is that it sometimes takes considerable time for dysfunctional temporomandibular joint complexes to become stable

even though they have been placed in a good functional environment. Dyer (1973)¹⁰ reported, in treating temporomandibular joint disorders with occlusal orthopedic splints, that most joints became "stable" in less than two or three months; however, some condyle positions changed for as long as two or three years during and following treatment in severe cases. These long convalescent periods are usually in patients who have been shifting the condyles laterally a great amount in order to intercuspal the teeth, or in severe retrognathic relations of the mandible. In any event, the practitioner should be aware of the possible changes in centric position of the condyles and the subsequent effect on the intercuspal position of the teeth (Moffett, Johnson, McCabe, et al, 1964¹¹).

A common practice in occlusal rehabilitation is to leave the anterior teeth slightly out of centric contact or to have them with a "long centric." Although these conditions may be sufficient for some patients they are not present in ideal natural dentitions. These practices are questionable in the light of neuromuscular physiology. There seems to be no valid reason why anterior teeth, as well as posterior teeth, should not have centric position contacts.

A practical way to monitor changes in condylar positions is by testing for anterior centric position contacts with thin marking ribbon such as 0.0005 inch mylar. Any seating of the condyles more superiorly will cause the posterior teeth to contact first and result in a loss of centric contact between the anterior teeth.

ANTERIOR CROWN LENGTH AND POSITION

It has been postulated that the wearing down of teeth by certain primitive tribes (such as aborigines and Eskimos), with little or no temporomandibular joint dysfunction or periodontal disease, may be proof that nature intends the teeth to wear that same way in other races. On the other hand, the factors which systematically predispose one to periodontal disease are usually not present in these primitive people. These races usually have strong bone and muscle, and this, coupled with their rough diet, causes wear. If we conclude that excessive wear on teeth is a result of either abnormal chewing habits or bruxism, then wear on the teeth should be considered harmful and should be prevented if possible. In view of modern man's eating habits, types of food, and stress levels, to say nothing of esthetic

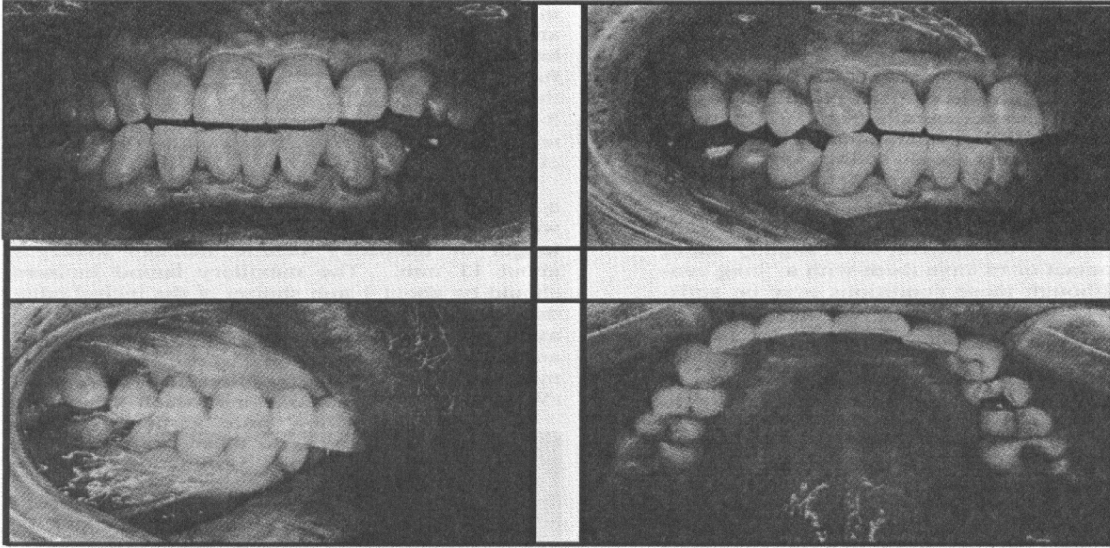
requirements, the arguments for worn teeth do not seem valid.

In discussing the biologic means for guiding the mandibular teeth into full occlusion, consideration must be given to tooth position and morphology which 1) produce good function, 2) show the least amount of wear on teeth, 3) minimize trauma to periodontal structures, 4) minimize trauma to temporomandibular joints, and 5) promote comfortable muscle activity. It has been found that people whose occlusion best fulfills the foregoing requirements which cause the mandible to function more vertically (Figure 3-7). Rarely, if ever, do these people develop temporomandibular joint dysfunction or myofascial pain problems.

In order to have good anterior guidance, a patient must first have normal length and unworn occlusal surfaces. The cervico-incisal length of maxillary central incisors averages about 11 mm. The maxillary lateral incisors should be about 1 mm shorter at the incisal edge than the central incisors. The maxillary cuspids average from 11 to 12 mm. The lower central and lateral incisors usually range from 9 to 10 mm long, and the lower cuspids are 11 to 12 mm (Wheeler, 1974¹²).

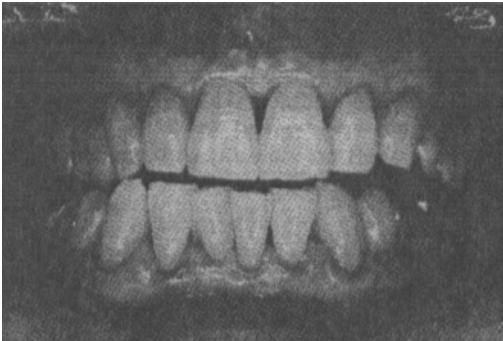


A
Figure 3-7 Legend on next page



F

Figure 3-7 The natural dentition of an 84-year-old man (A), showing excellent intercuspation arrangement and anterior overlap (B). The teeth have maximum intercuspation at centric position of the condyles and the anterior teeth have centric position contacts (C), (D) and (E) show the effects of good cuspid position and crown length, which cause the mandible to function more vertically and help to prevent the posterior teeth on both the working and nonworking sides from making eccentric contacts. Patients with tooth arrangements like this show the least amount of wear on their teeth (F), and seldom if ever develop temporomandibular joint dysfunction pain syndromes.



An ideal overlap of the maxillary anterior teeth will allow the incisal edges of the lower anterior teeth to touch the maxillary teeth approximately half way between the cementoenamel junction and the incisal edges when the mandible is in centric position (Figure 3-8).

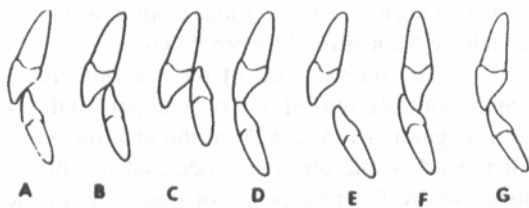


Figure 3-8 Of the various anterior teeth relationships; A is ideal, B is marginal while C, D, E, and F make long range success in occlusion far less probable. G has minimal overlap which is usually not adequate for long range success.

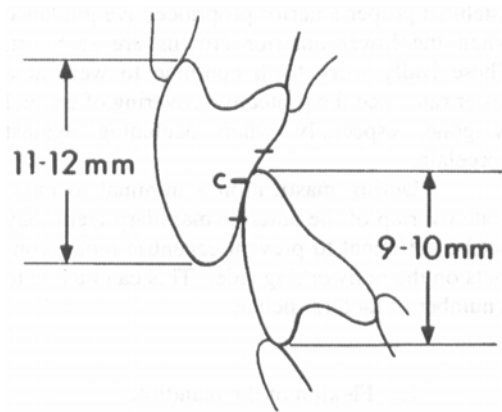


Figure 3-9 In order to have proper anterior guidance, the front teeth should have normal unworn clinical crowns so that the overlap will be sufficient to guide the mandible to centric position in a more vertical manner. The incisal edge of the lower anterior teeth should touch in the middle third of the maxillary anterior teeth in centric position C.

In most instances, the range for lower anterior incisal edge contacts can be anywhere in the middle one third of the lingual surface of normal length maxillary anterior teeth, and there will be adequate overlap for good guidance of the teeth to centric position (Figure 3-9). The steepness or tightness of the overlap should be maximized within the limits of good tooth morphology. It is perhaps better to have the overlap error on the side of too much and too tight rather than too little and too loose. If the error is too much and too tight, it is usually possible for the natural teeth to be adjusted or artificial crowns to be reduced after they have been permanently placed in the mouth. There is little or no chance

to add to artificial crowns, once they have been permanently placed, without remaking them. There are advantages in having the facial angles of the anterior teeth be as near normal as possible. These angular inclinations range from 98° to 113° for maxillary incisors and 85° to 104° for lower incisors (Graber, 1972¹³). The maxillary lateral incisors should be about 1 mm shorter than the central incisors to allow room for the lower cuspid cusp tips when the mandible is in the edge-to-edge incisive position (Figure 3-10).

Both upper and lower anterior teeth should have good arch forms from cuspid to cuspid, with little or no crowding of the teeth, so that the incisal edges of the lower anterior teeth can touch evenly in the lingual concavity of the maxillary anterior teeth when the mandible is in centric position (Figure 3-11).

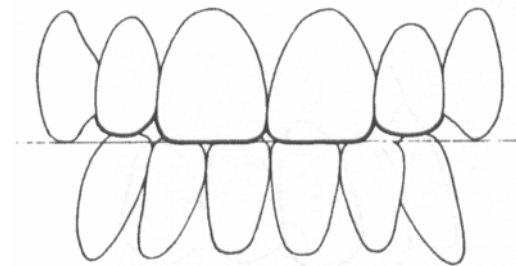


Figure 3-10 The maxillary lateral incisors should be at least 1 mm shorter than the central incisors to allow room for the cusp tips of the mandibular cuspids in a protrusive incisive position.

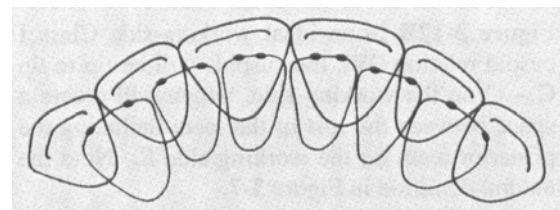


Figure 3-11 Both upper and lower anterior teeth should have good arch forms from cuspid to cuspid, with little or no crowding so that the incisal edges of the lower teeth can touch evenly in the lingual concavity of the maxillary anterior teeth when the mandible is in centric position.

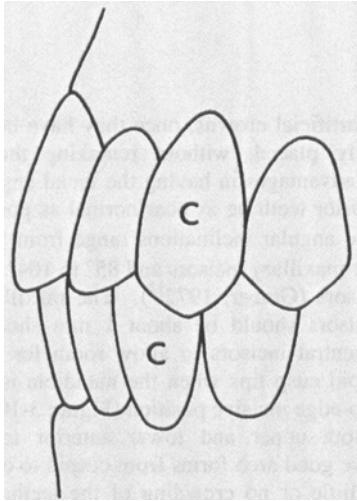


Figure 3-12A The crown of the maxillary cuspid functions best as a lateral guide when it is positioned in the embrasure distal to the mandibular cuspid when the mandible is in centric position.

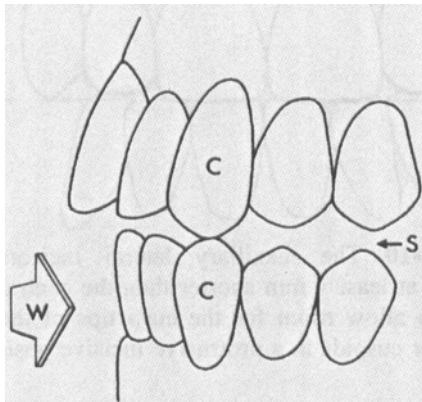


Figure 3-12B In an ideal working-side Class I cuspid relation (W), the cuspid will be tip to tip C – C on the working side, which will create a space between the rest of the teeth including the posterior teeth on the working side S. Note the natural dentition in Figure 3-7.

The cuspid function best when the maxillary cuspid occludes into the embrasure distal to the mandibular cuspid (Figure 3-12).

Esthetics and phonetics are both important factors to be considered when dealing with the anterior teeth. Usually both of these requirements can be fulfilled better by restoring the

patient to normal anterior tooth lengths when the teeth have been severely worn down

The incisal third of the anterior crown length controls almost all of the potential for vertical guiding function from the anterior teeth. All too often one observes “occlusal rehabilitations” where the four posterior quadrants of the mouth have been treated with gold or porcelain crowns but where the natural anterior teeth or artificial crowns are left in a poor relationship. Sometimes the anterior crowns are only one half to two thirds as long as they should be and yet are left untreated. This observation is especially noticeable on lower anterior teeth where practitioners are reluctant to operate because of the small size of the teeth. It is almost impossible to establish proper anterior proprioceptive guidance when the lower anterior crowns are so short. These badly worn teeth continue to wear at a faster rate once the protective covering of enamel is gone, especially when occluding against porcelain.

During mastication a minimal to moderate overlap of the anterior maxillary teeth may not be sufficient to prevent eccentric molar contacts on the nonworking side. This can be due to a number of factors such as:

1. Flexion of the mandible
2. Compressibility of the meniscus and periodontal ligament
3. Powerful masseter and temporalis muscles
4. Tough food on the working side acting as a fulcrum sometimes to tip the mandible enough to make molar contacts on the nonworking side
5. Wearing (shortening) of the anterior teeth
6. Flat condylar path
7. Large amounts of sideshifts
8. Improper posterior tooth inclinations

The results of these conditions can be improved by a proper overlap of the anterior teeth.

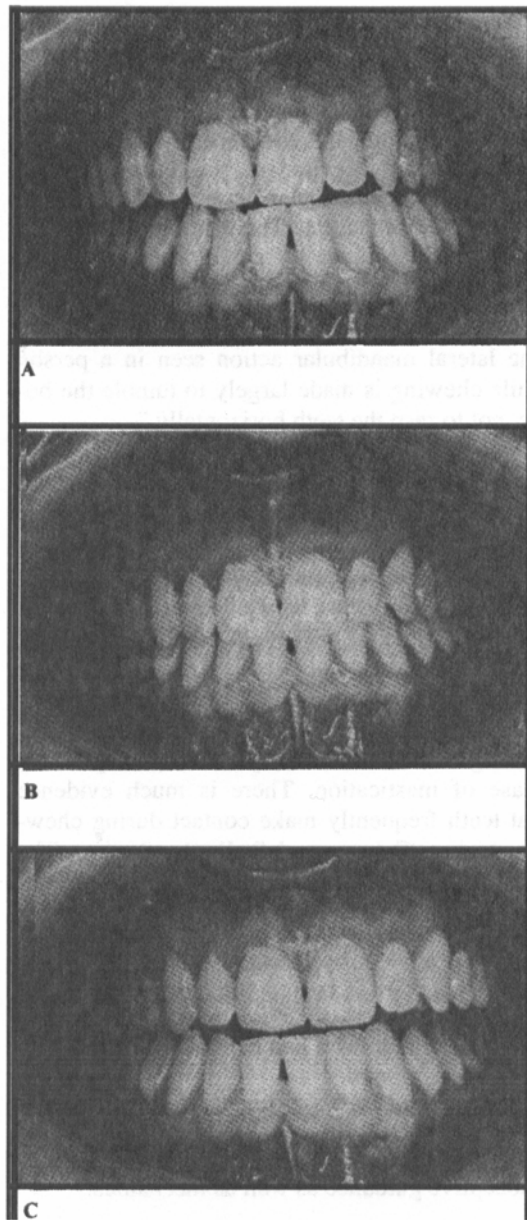
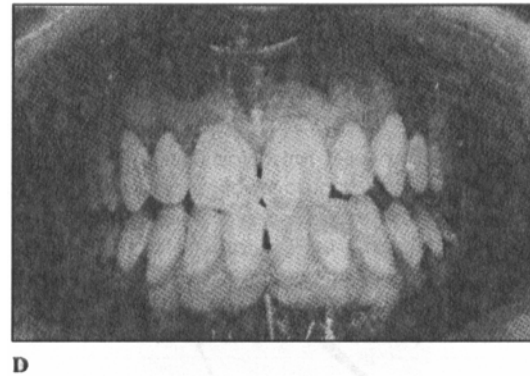


Figure 3-13 The healthy natural dentition of a female patient approximately 27 years of age. Note the good anterior crown length and overlap. (A) The separation of the posterior teeth is due to the cusp tips of the canine teeth. (B) shows the left canine controlling the closure toward centric position where the teeth will be in maximum intercuspation. (C) shows a right border position. There is usually a larger space on the non-working side than on the working side. (D) is an incisive position. Note the shorter maxillary lateral incisors which allow room for the lower canine tips.



IDEAL CHEWING STROKES

To have the least traumatic chewing strokes for the teeth and other organs of the masticatory system, it seems that the anterior teeth should guide the mandible into as vertical a motion as possible as the lower teeth approach the upper teeth on the way to centric position. The paths of ideal closing strokes are predicated upon normal anterior tooth lengths and positional relationships to their mates in the opposite arch (Figure 3-13).

The first phase of mastication is one of opening the mouth to take in food. This is followed by a lateral retrusive chewing motion. The food is placed with the tongue between the occluding surfaces of the posterior teeth on the working side and held there with the cheek and tongue. The mandible moves to the side on which the bolus of food has been placed. This movement to the working side varies from a slightly lateral position to as far as an end-to-end position of the cuspids. As the jaws close from a lateral working position to crush the food, the cuspids prevent the posterior teeth on both sides from touching. There is usually a wider space between the posterior teeth on the nonworking side than there is between the posterior teeth on the working side. (Gibbs, Suit. And Benz. 1973¹⁴ and Gibbs, Messerman, Reswick, et al. 1971¹⁵).

If the posterior artificial crowns or natural teeth have normal unworn morphology with good cusps fitting into fossae and proper grooves and embrasures for the food to escape,

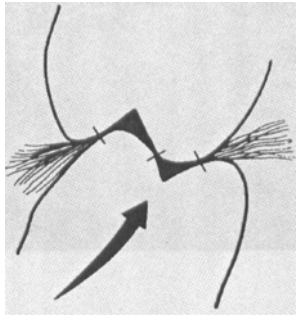


Figure 3-14 Posterior cusps and ridges can penetrate tough fibrous foods while traveling in a near vertical manner. Much of the tooth loading pressure is dissipated by the food extruding out through the grooves and embrasures, while the hard or tough pieces are crushed in the fossae by the cusps.

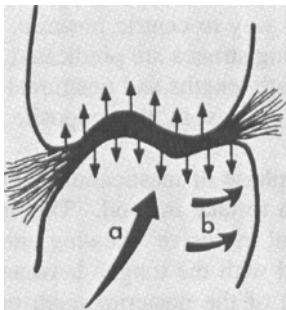


Figure 3-15 Flat occlusal surfaces, or those without proper ridges, grooves, cusps, and fossae, are not believed to be efficient for chewing tough or hard foods. This could result in excess loading on the teeth and periodontal structures. As the patient attempts to penetrate and shred tough fibrous foods, (a) the mandible may be forced into more horizontal bruxing-like motions in order to shred and tear the food. (b) Favoring continued wear on the teeth and stress on the masticatory system.

much of the food will be extruded through the grooves and embrasures while the cusps pierce or crush the harder and tougher pieces in the fossae (Figure 3-14). If a bolus of food is examined prior to swallowing, one can see that it is not pulverized, minced, or diced into micron-sized particles. It is a misconception about the normal masticatory process that food should be chewed with a bruxing action of the teeth (Figure 3-15). Stuart and Stallard (1960)¹⁶ stated that “chewing of modern foods for the most part is vertical. The lateral mandibular action seen in a person while chewing is made largely to tumble the bolus, not to rasp the teeth horizontally.”

During some chewing strokes, the mandible may move across the midline after it leaves centric position and briefly touch the cusps together on the nonworking side. However, these brief contacts are relatively nondestructive to the enamel of the cusps because the muscles are in the opening phase, and therefore little or no pressure is being applied.

Yaeger (1978)¹⁷ has recently published a comprehensive review of the literature concerning the mandibular path in the grinding phase of mastication. There is much evidence that teeth frequently make contact during chewing strokes (Scharer and Stallard, 1965¹⁸). The glide path coincides with the path of lateral motions of the mandible with the teeth in contact and no food in the mouth. The path of the mandible in the grinding phase is determined by the shapes of the contacting teeth and the condylar paths. Because of these potential tooth contacts, it is important clinically that chewing strokes be directed vertically as much as possible. The anterior teeth are in the best location to control the amount of vertical mandibular motions by proprioceptive guidance as well as mechanics.

VERTICAL DIMENSION AND REST POSITION

Although it is still believed by some that it is extremely risky to change the vertical dimension of occlusion, it should be recognized that orthodontics and other rehabilitative restorative disciplines have been successfully changing it for many years (Lee and Gregory, 1971).¹⁹ Figure 3-16 shows a cephalometric tracing of a 53 year old female who had her vertical dimension increased 4.5 mm.

Ramfjord (1971)⁸ found that the interocclusal distance averages 1.7 mm in the clinically determined rest position, whereas the average distance was 3.29 mm with an additional resting range of 11 mm when determined on the basis of minimal muscle activity. He states that determining the clinical rest position also involves the influences of emotional and exteroceptive and proprioceptive inputs to the neuromuscular system. Such inputs from joints, muscles, lips, cheeks, periodontal membrane, mucosa, teeth, and tongue *undoubtedly* contributed to the *learning* of rest position or conditioning of reflexes. Concepts regarding the rest position of the mandible should be reevaluated and revised as the related neuromuscular mechanisms become understood.

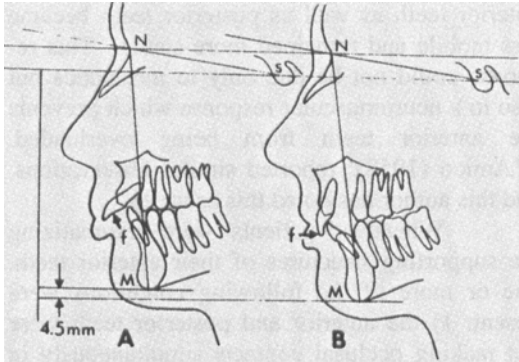


Figure 3-16 Cephalometric tracings before and after orthodontic treatment on a 3 year old female patient. In A, note the poor lip profile. The lower lip acts as an orthodontic force (f) to protrude the upper anterior teeth. In B, the anterior teeth have been orthodontically positioned so that the lower lip holds the upper anterior teeth back against the lower anterior teeth. Note also the improved inclinations of the anterior teeth (B), and that the lower anterior teeth contact the lingual fossae of the upper anterior teeth when the jaws are in centric position. A system of coordinates based upon the S, N and M points show the actual increase in vertical dimension to be 4.5 mm. The space between the posterior teeth in B will be occupied by restorations.

When changing vertical dimension of occlusion in restorative or prosthetic dentistry, excellent anterior guidance must be established, and the anterior teeth or crowns must have centric position contacts with the opposing teeth. The patient is learning a new vertical rest posi-

tion as well as new chewing patterns at the same time, and the learning process is greatly enhanced by a good anterior guidance.

TEMPOROMANDIBULAR JOINT DYSFUNCTION AND MYOFACIAL PAIN

A patient with temporomandibular joint dysfunction or myofascial pain syndrome rarely exhibits a naturally developed and maintained tooth arrangement with stable mandibular anterior teeth (with normal crown lengths). The axial inclinations and tooth positions allow the incisal edges of the lower anterior teeth to touch the middle one third of the upper anterior teeth in centric position and this overlap is sufficient to confine eccentric contacts to the anterior teeth. People who develop and maintain ideal anterior tooth relationships do not develop temporomandibular joint pain dysfunctions. There are, of course, other diseases or conditions which cannot be corrected by improving the patient's occlusion.

Patients suffering from temporomandibular joint dysfunction and myofascial pain exhibit one thing in common; they cannot return the mandible to centric position of the condyles from all eccentric positions while maintaining continuous contact with the appropriate anterior teeth.

The author has found, in giving patients suffering with temporomandibular joint dysfunction and myofascial pain an ideal anterior guidance, that the majority were relieved of pain symptoms did not reappear. In a low percentage (approximately 5%) of patients with temporomandibular joint pain dysfunction who were treated, pain persisted in the capsular area although it disappeared in the muscles. Patients who do not respond to treatment may be suffering from irreversible joint and nerve damage which may require more drastic treatment such as surgery or prolonged drug therapy. Crepitus often persists long after the muscles are functioning properly.

Occasionally a patient may be suffering from both a temporomandibular joint pain dysfunction syndrome and a neurologic disorder simultaneously. The two conditions are sometimes difficult to identify separately. Neurologists usually recommend that the occlusal problems be solved first and then the patient be treated for the neurologic disorder.

From the standpoint of restorative dentistry, it is prudent to test the patient with temporomandibular joint pain dysfunction with an

anterior guided splint. If pain and temporomandibular joint dysfunction persist, it is doubtful that improving the morphology or position of the teeth alone will solve the problem.

BRUXISM

Some authorities believe there are two separate causes for bruxism: they are 1) those of psychogenic origin and 2) those caused by occlusal disharmonies and emotional stress is a common denominator.

Ramfjord (1961)²⁰ states, "Some kind of occlusal interference will be found in every patient with bruxism." And "A marked reduction in muscle tonus and harmonious integration of muscle action follows the elimination of occlusal disharmony." Dawson (1974)²¹ feels that all bruxism is caused by occlusal disharmonies and that the clinician should improve his skills and observations in order to eliminate them. He states, "It has been our clinical experience that bruxism can be stopped by complete elimination of all occlusal interferences."

Excessive wear on anterior teeth is often observed in patients who have retained the third molars into adulthood. Because of tenderness or pain in the third molar areas these patients tend to develop patterns of avoidance of the molars and to function more anteriorly. This forward function causes early wear on the anterior teeth and a loss of good anterior guidance. "High crowns" and other posterior occlusal disharmonies also cause wear on the anterior teeth through avoidance patterns. Some clinicians believe that leaving the anterior teeth in a worn condition and removing "all" posterior interference is adequate treatment for bruxism. While it is helpful to equilibrate patients who have worn front teeth, it has been found that these patients develop more interferences and continue to require more equilibrating. Eventually, the dentist is faced with the inevitable decision that the dentition must be restored.

Two serious questions which face the clinician are: 1) How far should the anterior teeth be allowed to wear down before restoring them? And 2) If the anterior teeth must be restored, how long should the crowns be and how much overlap should they have?

After giving patients steeply guided (ideal) anterior guidance as a primary means for avoiding eccentric posterior interferences, a complete cessation of bruxism has been observed in most patients, and bruxism was reduced to a minimum in the remaining patients. This loss of

bruxism leads to the speculation that anterior tooth relations have a greater influence upon the state of the central nervous system than is commonly believed.

PERIODONTAL CONSIDERATIONS

It has been argued that because of unfavorable axial inclinations, the anterior teeth cannot take the loads of mastication and may be loosened in their supporting tissues, but this is not the cause. The proprioceptive protective mechanism better protects the anterior teeth from overloading than mechanics alone would.

Arnold and Frumker (1976)²² and Ramfjord (1971)* have reported that when patients were equilibrated so that the anterior teeth gave complete guidance to maximum intercuspal position at centric position of the mandible, mobile anterior teeth as well as posterior teeth became less mobile and remained more stable. This response could not be due only to mechanics but also to a neuromuscular response which prevents the anterior teeth from being overloaded. D'Amico (1958)² reported similar observations, and this author has noted this as well.

Whenever patients were traumatizing the supporting structures of their anterior teeth, one or more of the following conditions were present: 1) the anterior and posterior teeth were not making occlusal contacts simultaneously in centric position, 2) there was improper overlap of the anterior teeth to guide the mandible to centric position without interference from posterior teeth, and 3) there was a lack of adequate posterior tooth support. The lack of good anterior guidance produces unharmonious muscle activity, which can cause the anterior teeth to be traumatized. It should be remembered that with the loss or damage of periodontal tissues there is also a loss or insensitiveness of periodontal pressure receptors as well as mobility of the teeth. Splinting of anterior teeth often helps to increase loading awareness as well as to distribute the loads mechanically.

EFFECTS OF CONDYLAR SIDESHIFT

The term *sideshift* is misleading because it denotes a horizontal movement such as is used by football teams at the line of scrimmage. The condyles rarely move purely horizontally but instead translate and rotate in curvilinear

paths in the three planes of space simultaneously. Sideshift may be defined as a looseness of fit or slackness of the condyles in their fossae and is usually noted when the mandible is making lateral movement to and from centric position (Bennett, 1908²³).

Movements of the condyles cannot be defined precisely because of their size and irregular shapes, or because of the irregular shapes of the fossae in which they move. A more accurate description may be made by observing the movements of the transverse (hinge) axis which is common to both condyles and can be located with some degree of accuracy. These movements can be observed as points on the transverse axis, which must remain a fixed distance apart for measuring or observing their relative movement (Lee, 1969²⁴ and Lee, 1969²⁵).

Lundeen and Wirth (1973)²⁶ compared hinge-axis tracings of fifty patients taken at random. They found that immediate sideshift accounted for the greatest variation between patients when the condyle movements were viewed in the horizontal plane. It is not known at this time how, if any, of this lateral looseness in the joints might be pathologic or what causes it. It appears to be connected with growth and development and muscle function in certain types of malocclusions. The author found that sideshift could be induced in 99% of 220 patients taken at random (Figure 3-17). It ranged from 0.5 mm to as much as 5.0 mm for right and left border movements combined. It has been noted that patients with large amounts of sideshift were usually of the deep overbite class.

Although there is widespread teaching that condylar sideshift should be incorporated into the anatomy of anterior crowns (Figure 3-18), there is no observable correlation in the natural anterior dentition to substantiate such claims. For example, patients who exhibit significant amounts of immediate sideshift have lingual anatomy of their cuspids and incisors which closely resembles that of patients who have little or no immediate sideshift.

It is commonly believed that patients who have worn the occlusal or incisal surfaces of their teeth a great deal must necessarily have large amounts of immediate sideshift. However,

**Distribution of
Immediate SideShift for 220 Patients
OPERATOR INDUCED**

SideShift in Millimeters	0-.5	.5-1	1-2	2-3	3-4	4-4.5
Number of patients	2	34	116	48	18	4

*Right and left border movements combined

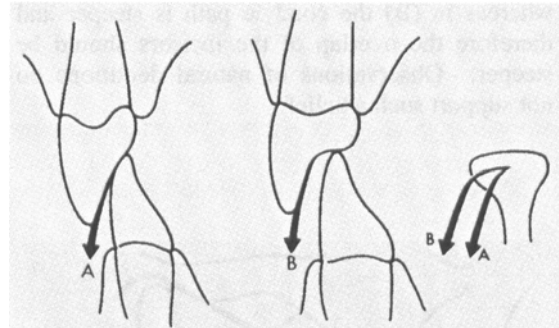


Figure 3-17

Figure 3-18 There is widespread belief that the lingual anatomy of cuspid crowns should directly reflect the magnitude of condylar sideshift. Condyle path (A) with little sideshift would have maxillary cuspid lingual configuration (a), whereas condyle path (B) with more sideshift should have maxillary cuspid lingual anatomy (B). Observations of natural dentitions do not support such a belief.

patients with greatly worn teeth usually exhibit no more than average amounts of sideshift. Large amounts of immediate to progressive sideshift are often found in patients with excessively deep overbites, such as the Class II, Division 2. Excessive amounts of sideshift appear to be connected with the stretching of the temporomandibular joint ligaments due to abnormal pterygoid muscle action during growth and development.

Others believe that the overlap of the anterior incisors should be related directly to the slope of the protrusive condylar path (Figure 3-19). At present there is no scientific proof of such a relationship. From a mechanical point of

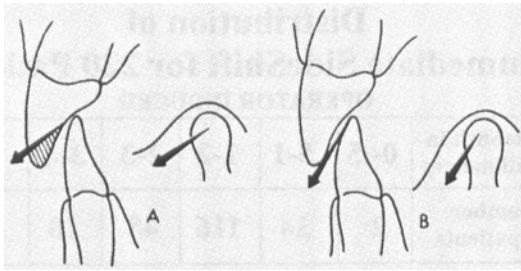


Figure 3-19 It is believed by some that overlap of the anterior incisors should relate directly to the slope of the protrusive path. In (A) the condyle path is more horizontal and therefore the incisors should have less overbite and overjet, whereas in (B) the condyle path is steeper and therefore the overlap of the incisors should be steeper. Observations of natural dentitions do not support such a belief.

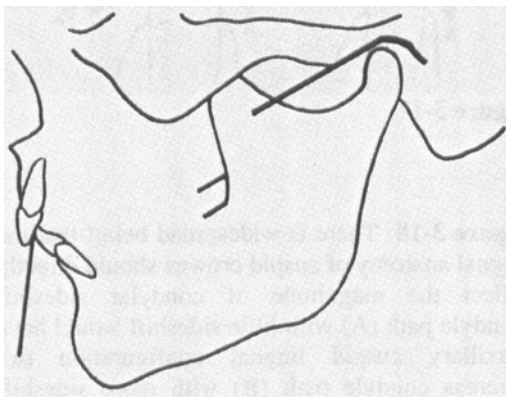


Figure 3-20 It is more logical to have a steeper overlap of the anterior teeth when the condyle paths are flatter. This is because the anterior teeth must overcome the effect of the flat condyle paths, which tend to bring the posterior teeth into eccentric contact.

view, this one-to-one relationship appears desirable, provided the condyle paths are in the steeper range. However, if the condyle paths are flatter, this scheme is difficult to defend. It is more logical to have a steeper overlap of the anterior teeth in case of a shallow protrusive condyle path to prevent posterior eccentric contacts (Figure 3-20)

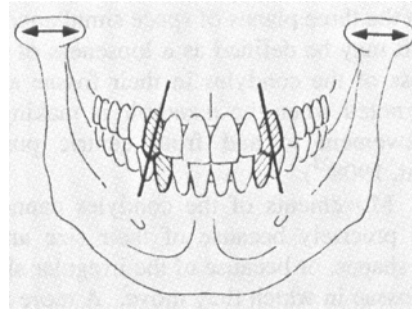


Figure 3-21 It is desirable to have maximum vertical guidance by the cuspids even when there are large amounts of “sideshift”. In this way the cuspids are the primary means of preventing eccentric posterior contacts since there is little help from the condyles because of their more horizontal motion.

So far, no relationship has been established between the individual morphology of the natural anterior teeth and condylar movements. There is some evidence, however, that the steepness of the eminences may be influenced during growth and development by the *position* of the teeth in the arches and skeletal relationships. The relationships of the teeth during jaw closure influence the pull of the muscles through stimulation from the central nervous system. The influence of muscle activity is observed in skeletal Class III patients often having shallow angles of eminence and excessive amount of sideshift. In view of the potential effects of muscle action on the shapes and sizes of bones and ligaments during growth and development, it is urgent that early treatment can be instituted to establish good tooth-guiding relationships.

Occlusal rehabilitations have historically considered condylar movements and the manner in which these movements affect the occlusal surfaces of posterior artificial crowns or equilibrations of natural teeth. Condylar sideshift can have more of an effect on posterior occlusal restorations, especially in patients where there is not good overlap and crown length of the anterior teeth. Lundeen, Shryock, and Gibbs (1978)²⁷ have shown that in some patients with fairly good cuspid relations, the posterior teeth still approached the posterior teeth in the opposite arch from a relatively critical horizontal angle. This critical approach of the posterior teeth is usually due to more horizontal condylar paths and sideshift.

If a patient has long, steep Class I cuspid relations, the cuspids will guide the mandible

into a more nearly centered position before the posterior cusps get close enough to contact. This guidance by the cuspids causes the sideshift of the condyles to be greatly dissipated since the condyles have moved more nearly to centric position during the final stage of the closing strokes (Figure 3-21).

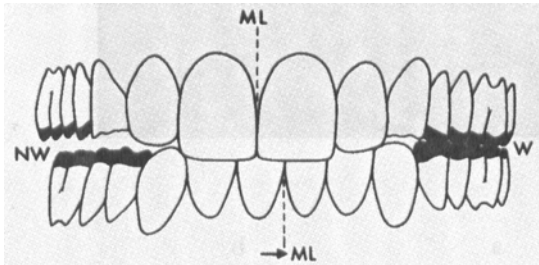


Figure 3-22 The cusps on the maxillary cast have been ground off so that they have no guiding effect. In this way the maximum amount of the patient's condylar "sideshift" can be incorporated into the posterior restorations. In the mouth the unworn cusps will act as a first line for vertical control. If the cusps eventually wear down the patient will go into working-side group function, which has been built into the posterior crowns. The working-side group function (W) acts as a second line of control to prevent nonworking-(NW) (balancing) side contacts.

GROUP-FUNCTION AND CUSPID GUIDANCE

It is commonly agreed by most authorities that there should be an absence of nonworking side (balancing) contacts of the posterior teeth in all lateral movements to and from centric position.

Some dentists believe that working-side group function is preferable to cuspid-guided occlusion and that it is better to distribute the stress of mastication over more teeth. From a purely mechanical point of view, this idea has merit. However, from a biologic point of view, based upon proprioceptive cuspid guidance, group-function occlusion is not the ideal form of occlusion. Group-function occlusion often results in abnormal posterior artificial crown morphology which is too flat and broad to function efficiently. These flat occlusal surfaces encourage horizontal mastication and promote wear as well as overloading of teeth.

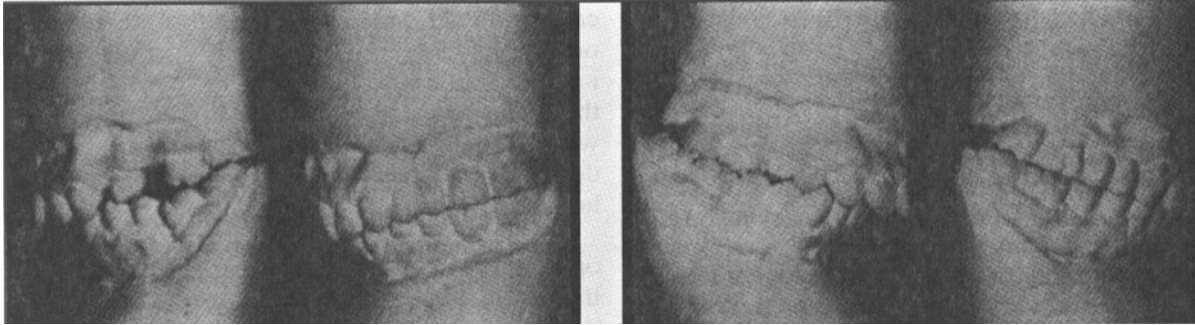
McAdam (1976)²⁸ reported that both canine-guided and working-side group function

occlusions are physiologically acceptable in natural dentitions; however, he concludes that the group function occlusions are due to occlusal wear. He illustrated that vertical function is less destructive to the teeth and related organs than horizontal chewing.

If the posterior teeth are to be restored or reconstructed, the cusps can be ground off in the mounted working casts on the articulator, thus removing their influence on the posterior crowns being fabricated. This will allow the operator to wax, cast, and adjust the posterior crowns to incorporate the effects of condylar sideshift. By doing this one can produce a working-side group-function scheme for the posterior teeth in case the anterior cusps wear down over the years (Figure 3-22). In the mouth, the cusps would act as a first line of control to keep the mandible functioning more vertically.

ORTHODONTICS AND ORTHOGNATHIC SURGERY

Orthodontics should always be given primary consideration when planning the treatment for patients with poor relationships of the anterior teeth (Kahn, 1977²⁹). Figure 3-23 shows the establishment of a good anterior as well as posterior relationship for a 42-year old man. After the anterior teeth were positioned properly, routine restorations were used for the posterior teeth. Patients with this type of anterior guidance have a much better chance for keeping their masticatory system in good health than they would if their posterior teeth were rehabilitated without correction of the anterior relations of the teeth. In patients where it is not feasible to do orthodontia, the possibilities of orthognathic surgery should be explored to get better relations of the anterior teeth. Sometimes, orthodontia and orthognathic surgery as well as restorative procedures are required to solve the occlusion problems.



a

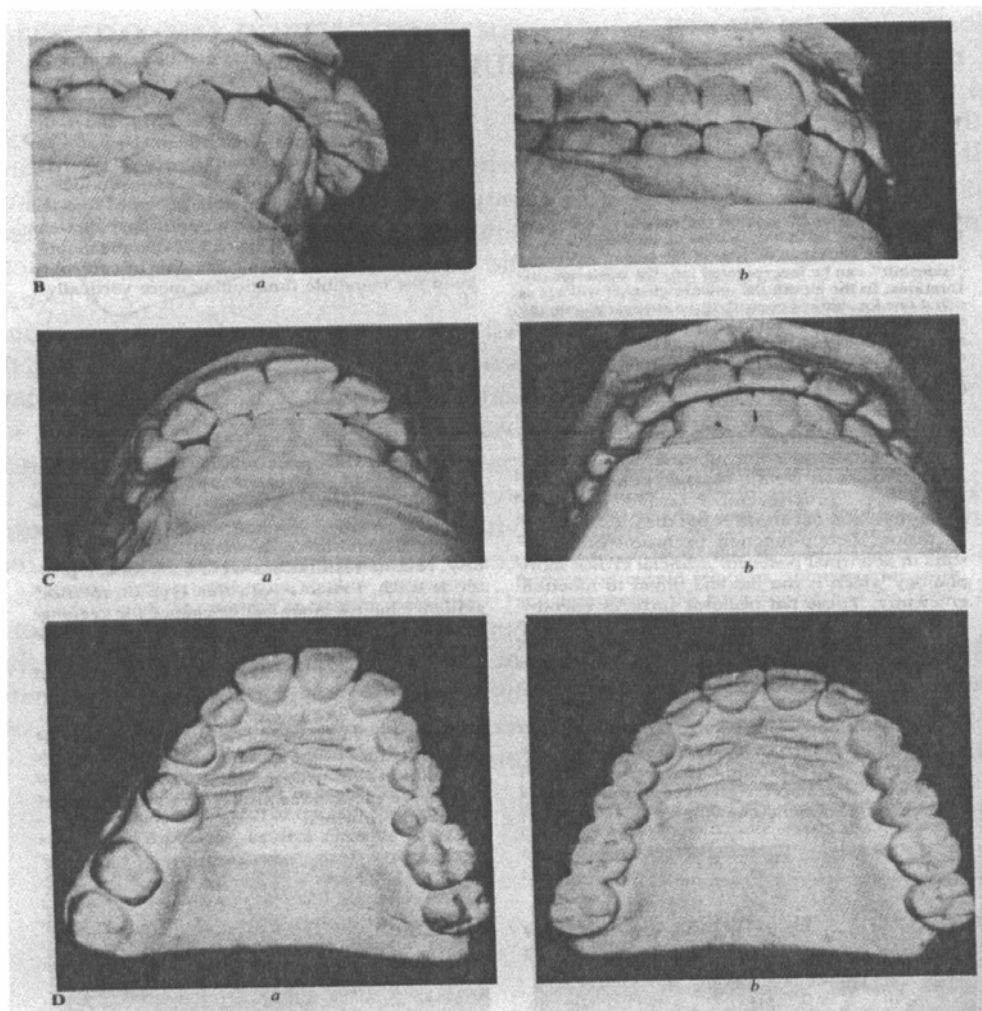
Left

b

a

Right

b



B

a

b

C

a

b

D

a

b

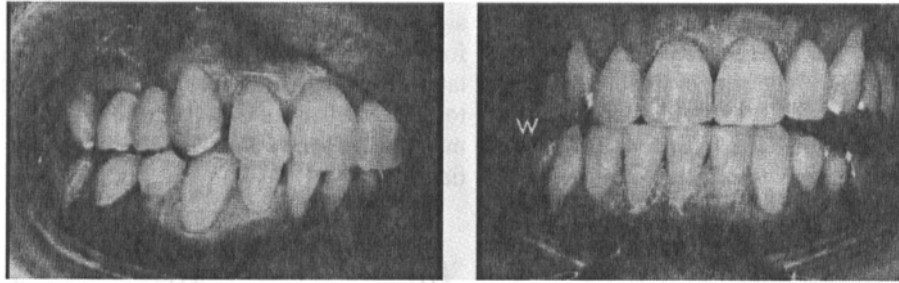


Figure 3-23 Before and after treatment models of a 42-year old male patient who had prerestorative orthodontics to obtain a good position for the anterior teeth as well as the posterior teeth. Original casts (a) and postrestorative casts (b). Note in (A) the canines and molars have been positioned in Class I relation with proper angulation. (C) shows that the constricted arches have been developed to proper arch form. During therapy the vertical dimension was gradually increased, allowing the reduction of the excessive overjet and overbite. (D) shows good anterior tooth positions in the patient's mouth. In (E) the mandible is in a right working-side position (W).

A common error in contemporary orthodontics is not to give the patient enough overlap of the anterior teeth. Even when the teeth are equilibrated, there is rarely enough overlap to give him good vertical chewing strokes and well-controlled muscles. Many patients after treatment must function in an abnormal way which often leads to severe wear on the teeth or temporomandibular joint or to problems of myofascial pain. Almost all adults and "occasionally" children require equilibration following orthodontic treatment. However, "proper" equilibration procedures are not usually done at present (Roth, 1976³⁰).

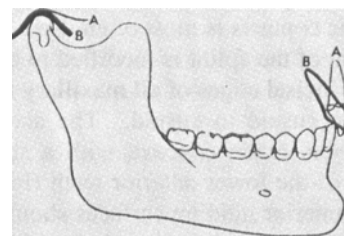
Most orthodontic treatment is somewhat traumatic to the teeth and supporting structures, especially in adults, evidenced by such conditions as recession of the gingiva or root resorption. The convalescence and stabilization period usually prolongs the final occlusion treatment time. This should be taken into consideration when designing a treatment plan for the adult patient (Chiappone, 1976³¹).

One of the most productive orthodontic goals with a relatively short time for accomplishment is straightening the lower anterior teeth and giving the arch a good parabolic curve. If the lower anterior teeth have been disturbed or moved, a fixed lower anterior retainer with a lingual support should be placed for at least a year or more. The foundation for good anterior guidance is based upon the lower anterior teeth. When these teeth begin to crowd and the cuspids tip lingually, the occlusion is beginning to collapse.

If complete orthodontic treatment is not feasible, a compromise treatment is sometimes

adequate to put the teeth close enough so that the case can be finished restoratively. If compromises are to be made orthodontically, it is better to make them in the posterior teeth and concentrate the efforts in gaining the best possible relationships for the anterior teeth. (Figure 3-24). For example, it would be better to leave the molars in a Class II arrangement or perhaps a cross bite and get the anterior teeth in good relationship than to get a perfect relationship of the posterior teeth and leave the anterior teeth in a poor arrangement. Another acceptable compromise might be the extraction of the maxillary first bicusps to reduce an anterior Class II relation in an effort to get better anterior proprioceptive guidance. All orthodontic treatment should be completed prior to equilibration and restorative procedures.

Figure 3-24 The more horizontal anterior tooth



position (B) will work with a steep condyle path (B) in preventing posterior eccentric interferences. However, if the anterior teeth are moved to position (A) they will function equally as well for condyle paths (A) and (B). In other words, gaining a better overlap of the anterior teeth makes the effects of condyle movements less critical on posterior teeth.

Restorative dentists should recognize the importance of proper anterior guidance and the frequent necessity for prerestorative orthodontics. Orthodontic specialists are valuable in treating these patients; however, ultimate responsibility for the success of the total treatment usually belongs to the referring restorative dentist. Therefore, he should give the orthodontist a detailed description as to where and why he needs the teeth to be positioned. At the same time, he should respect and appreciate the limitations of orthodontic treatment. Each case should be discussed in detail and written notes made before and during treatment so that both the orthodontist and the restorative dentist understand the goals and limitations of the other.

As orthodontists and restorative dentists work together and continue to improve their knowledge of dynamic occlusion, the problem of postorthodontic equilibration will no doubt be resolved. Orthodontists, as well as the referring practitioner, should advise patients of the possible need for postorthodontic equilibration. The combined efforts of orthodontics and restorative dentistry no doubt holds the most hope for long-range successful solutions to adult malocclusions.

TRAINING SPLINTS AND TEMPORARY CROWNS

Patients who are to be equilibrated or who are to undergo anterior restorations should routinely be placed on a training splint for a period of a few days to a few weeks. A modification of the maxillary fronto-plateau type described by Krogh-Poulsen and Olsson (1968)³² for separating the posterior teeth from any centric or eccentric contacts is most often used. The anterior portion of the splint is modified to come down over the incisal edges of all maxillary anterior teeth from cuspid to cuspid. The anterior lingual portion is made concave with a steep overlap of all of the lower anterior teeth (Figure 3-25A). The anterior guiding surfaces should be polished smooth with no bumps or ledges for the lower teeth to catch on. Patients with myofascial pain are instructed to wear the splint 24 hours a day and eat a soft but nutritious diet. When the muscles are free from tenderness, a posterior occlusal surface can be added so that the patient can function in centric position on the posterior teeth as well as the anterior teeth (Figure 3-25B).

Splints do not transmit proprioceptive signals as well as natural teeth. Since they are foreign objects in the mouth, they can be an irritation to some patients. However, they do work to relax the muscles and stabilize the temporomandibular joints for the large majority of patients.

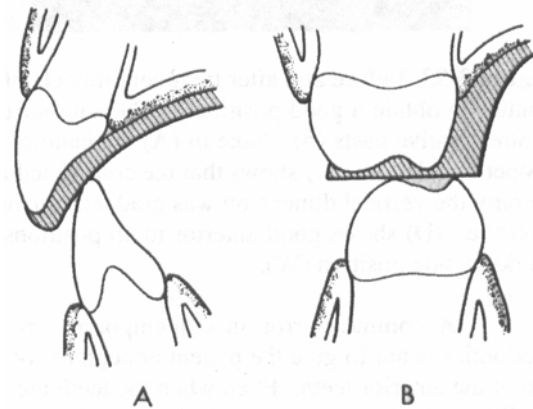


Figure 3-25 Maxillary training and treatment splints are a modification of the fronto-plateau type. (A) The anterior portion is made to come down over the incisal edges of all maxillary anterior teeth from cuspid to cuspid. It is built concave with a steep overlap guidance to centric position. (B) If the patient must wear a splint for a prolonged period of time to treat a temporomandibular joint pain dysfunction, the splint is made to cover the occlusal surfaces of the posterior teeth so that the lower posterior teeth can occlude in centric position.

Following splint therapy, the patient is ready for occlusal equilibration or restorative procedures. If the anterior teeth are to be crowned, plastic temporary crown splints should be made to a normal crown length of 11 to 12 mm. The temporary splint should be made with a steep overlap of the lower anterior teeth. The temporary crowns act as a test and as a training splint, and should have centric position contacts with all lower anterior teeth. They should also provide 100% guidance of the mandible from all eccentric positions to centric position. By the time the permanent restorations are ready to be placed in the mouth, patients will have learned to function more vertically through the use of the anterior occlusal splint and temporary crown splint. (Figure 3-26)

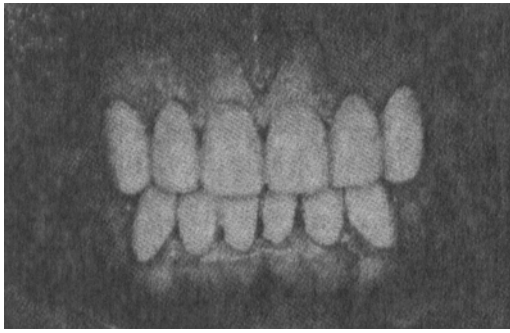


Figure 3-26 Anterior temporary crowns are an important part of temporomandibular joint and muscle treatment as well as testing and training devices for learning anterior guidance. The temporary crown splints should have full clinical-crown length and “steep” overlap as well as centric position contacts with the opposing teeth. All eccentric contacts should be on the anterior temporary crown splint. It is preferable to use solid splints rather than individual temporary crowns. Refer to patient in Figure 3-36.

EQUILIBRATION

In the practice of occlusal equilibrating, posterior eccentric interferences are removed, resulting in less muscle stress; however, there is a tendency to produce more horizontal chewing cycles, and therefore wear on the teeth usually continues. A number of texts are available on method and rules for equilibrating posterior teeth, and no attempt will be made in this chapter to discuss this phase (Ramfjord and Ash, 1976³³).

All patients' casts should be mounted in centric position on an articulator, which simulates the individual patient's characteristic jaw movements. It should be determined if the lower anterior teeth can be brought into centric position contact with the upper anterior teeth without overgrinding the posterior teeth. If it is doubtful that centric position contacts can be made with the anterior teeth, the treatment plan may have to include orthodontia or restorative measures. In this event, the patient should be advised and the equilibration postponed.

If the posterior teeth can be adjusted adequately on the mounted casts, the procedures are then carried out in the mouth until there are centric position contacts between the lower and upper anterior teeth (Figure 3-27). Mylar mark-

ing ribbon (0.0005 inch thick) is the best material available at the present time for equilibrating teeth. To achieve 100% anterior tooth guidance to centric position, the reshaping of posterior teeth may be necessary, because the anterior teeth may not have the proper crown length or proper position arch. It must be recognized that most occlusal equilibrations are limited because tooth substance can only be removed from and not added to deficient areas. However, it is often surprising to see how much better the anterior guidance system works once the posterior teeth have been reduced so that the anterior teeth can make contact in centric position.

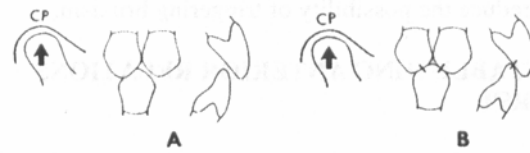


Figure 3-27 To derive maximum benefits from an occlusal equilibration, the anterior teeth as well as the posterior teeth should make simultaneous contact with the opposing teeth when the condyles are in centric position (CP). The posterior eccentric contacts in (A) should be removed until the anterior teeth make contact in centric position (B). The posterior teeth should be adjusted until the anterior teeth can guide the mandible to centric position without interfering contacts from the posterior teeth.

Occasionally, it is necessary to adjust some of the anterior teeth so that all of the teeth from cuspid to cuspid have centric position contacts with their mates in the opposite arch. This is usually done by adjusting the lingual surfaces of the maxillary anterior teeth rather than the incisal edges of the mandibular anterior teeth. It is important that the anterior teeth do not strike harder than the posterior teeth in centric position when the equilibration is made final. To check for fremitus, the operator's finger is placed lightly at the junction of the gingiva and crown at the same time. The patient rapidly taps the teeth together in centric position. If the tooth moves or vibrates, it is being hit too hard by the opposing tooth and the contact needs to be relieved. If any compromises are to be made, they should be with maxillary lateral incisors. The cuspid and central incisors at least must have centric position contacts.

It is impossible to tell how thick the tooth enamel is when equilibrating mounted study casts; therefore, discretion should be used when actually performing an equilibration in the mouth. If the operator finds that the posterior teeth will be over reduced during patient equilibration in order to get the anterior teeth to make centric position contacts, he should advise the patient that anterior restorations should be done.

All rough spots and ledges should be polished smooth after equilibrating so that the lower anterior teeth can slide smoothly against the uppers from all eccentric positions to centric position. This step is extremely important to achieve a good proprioceptive sensation and also to reduce the possibility of triggering bruxism.

ESTABLISHING ANTERIOR RELATIONS FIRST

If the anterior teeth are to be restored, it is advantageous to finish them first (Schuyler, 1959³⁴). The dentist can satisfy the esthetic and phonetic requirements more easily, and the anterior teeth can be used as a natural jig to stabilize the mandible and allow the condyles to seat uppermost in their fossae when restoring the posterior teeth. One of the disadvantages of restoring the posterior teeth first is that the dentist no longer has an opportunity to change the vertical dimensions of occlusion, and he may be obliged to make anterior restorations too long or too short for good esthetics, phonetics, and function in the event that the front teeth need restoring.

The anterior teeth or crowns can be conveniently used to stabilize the mandible and help capture centric position during posterior restorative treatment. The use of closed-bite centric records such as the Kerr (Jones) bite-frame is an example. These closed-bite registrations utilize the anterior (centric position) tooth contacts as a jig. If at least one right and one left posterior quadrant of the teeth have been prepared at one time, there will be nothing to prevent the condyles from going to the most superior position in the fossae (centric position) (Figure 3-28). Care should be taken to prevent the patient from applying heavy contracting muscle force, or the mandible may flex and produce a faulty centric position record.

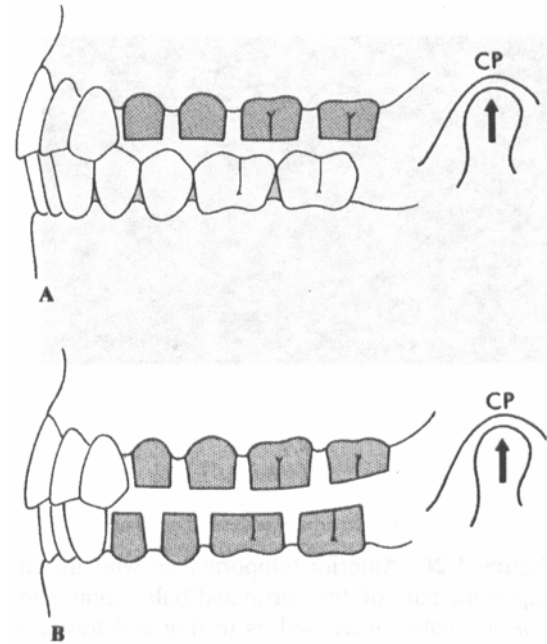


Figure 3-28 If at least one right and left posterior quadrant of teeth (A) or all four posterior quadrants (B) are prepared for crowns at one time, the anterior teeth will act as a jig to stabilize the mandible. There is nothing to prevent the condyles from going into the most superior position in the fossae (centric position). The use of a closed-bite centric record such as the Kerr (Jones) bite frame can be used.

RESTORATIVE MATERIALS

The materials, which come into contact with those in the opposite arch, should be as compatible as possible. It is best, of course, to have the enamel of the natural teeth in contact, but this is not always possible. The second choice is a good-grade, relatively hard gold against gold or against tooth enamel. The third choice of materials for wear resistance is porcelain against porcelain, and the worst is porcelain against tooth enamel or gold. Plastics and composites are only good for temporary usage. Esthetics, of course, is an important factor when dealing with the anterior teeth and therefore, the use of ceramometal crowns is increasing.

RESTORING CLASS II AND EXCESSIVE OVERBITE PATIENTS

If orthodontics cannot be utilized, innovations such as warping the lower anterior artificial crowns forward to make contact with the maxillary anterior teeth (Figure 3-29) or overcontouring the lingual aspects of the maxillary teeth, can be employed provided that



Figure 3-29 Warping lower anterior artificial crowns labially, or maxillary anterior crowns lingually can sometimes be employed to achieve satisfactory anterior guidance for patients with severe overjet. The pulp and length of the prepared crown are limiting factors.



Figure 3-30 Overcontouring the lingual aspects of maxillary crowns can sometimes be employed to establish acceptable centric position contacts with the incisal edges of the lower anterior teeth.

the gingiva is not overprotected or the production of phonetics impaired (Figure 3-30). Many moderate Class II canine relations (Figure 3-31A) do not create adequate canine guidance because the lower canine usually passes through the embrasure distal to the maxillary canine and, therefore, does not produce good vertical guidance for preventing posterioeccentric contacts (Figure 3-31B). This moderate Class II situation can often be connected by distally overcontouring the maxillary canine (Figure 3-32A and B). One method for simulating canine guidance in the Class II patient where the maxillary canine is anterior to the mandibular canine, is to remove the lingual cusp of the first premolar and reshape the crown like a canine, then to splint the maxillary canine to the first premolar with crowns (Figure 3-33A and B). Usually premolars are poor candidates for lateral chewing guidance, but splinting them to the canine makes them more acceptable.

In the case of some patients with deep overbite, such as Class II . Division 2, another factor enters into closing stroke patterns. Because of a wedging action of the anterior teeth and their continued tendency to extrude or migrate incisally along with their associated alveolar bone, the condyles are displaced in the fossae in a more downward and posterior direction from centric position (Figure 3-34). As the muscles seat the condyles into centric position, the anterior teeth strike too soon. Thus, the muscle may fatigue in the constant struggle to satisfy the intercuspal position of the teeth and the centric position of the condyles in the fossae. These patients are suffering from severe skeletal disharmonies and usually require orthodontics or sometimes orthognathic surgery, to rehabilitate their neuromuscular occlusion.

RESTORING SEVERLY WORN TEETH

Some authorities feel that if a patient has worn his teeth down severely, it is because the muscles demand freedom for movement and that it would be risky to give these patients a normal anterior tooth configuration with a normal overbite and overjet. It is speculated that the patient may knock the anterior teeth loose or develop muscle or temporomandibular joint problems. Figure 3-35A shows a patient who had worn all of this teeth extremely flat and was restored with normal-length anterior crowns and a steep overlap of the anterior teeth. Figure 3-35B shows the same patient after 11 years with little or no wear on the teeth and no development

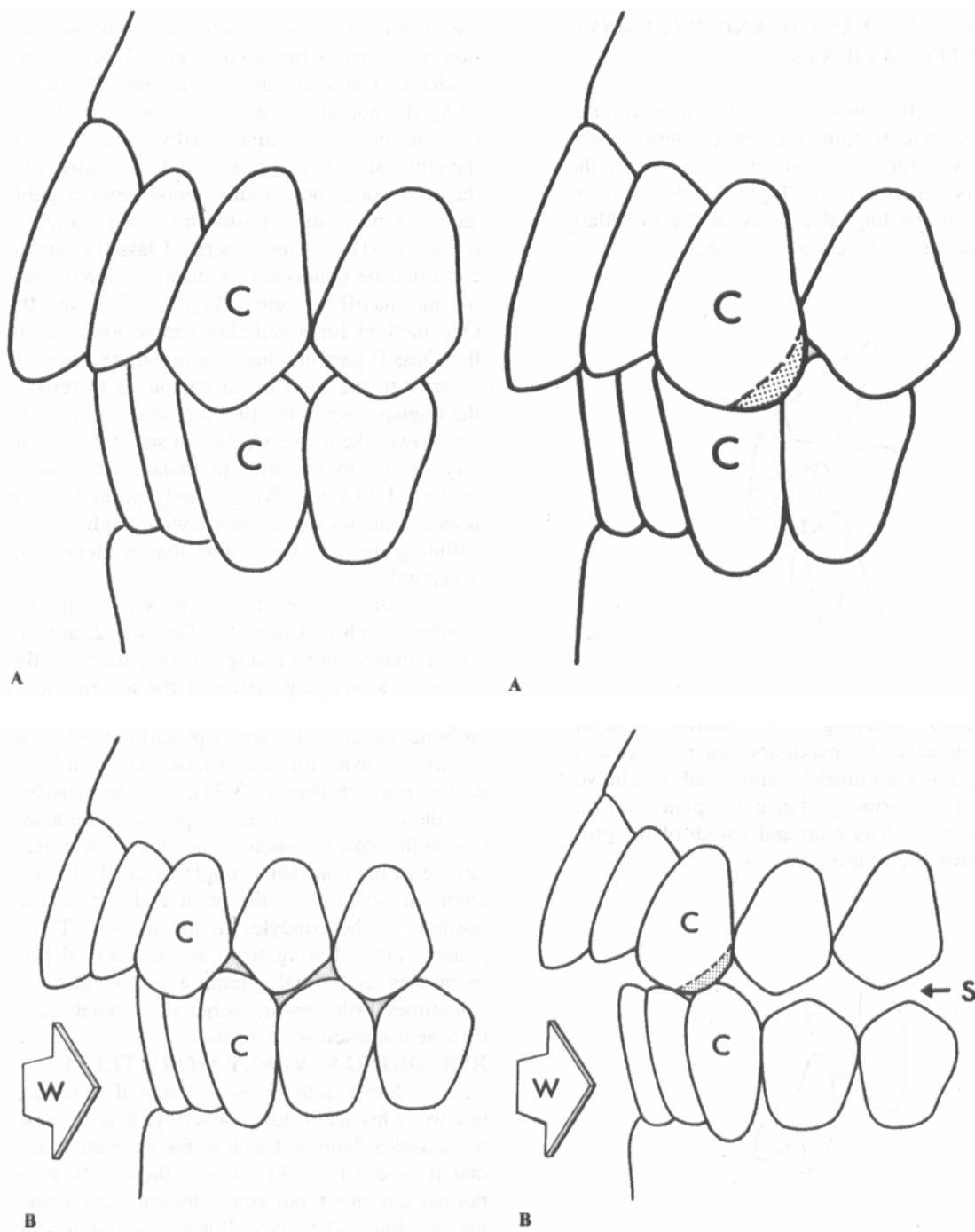


Figure 3-31A and B A moderate Class II canine relationship (centric position) does not create adequate canine guidance because the lower canine usually passes distal to the maxillary canine (B) and does not produce enough vertical guidance to prevent eccentric posterior contacts.

Figure 3-32A and B With a distally overcontoured maxillary canine, moderate Class II occlusion can often be given sufficient canine guidance to separate posterior teeth (S) adequately in lateral border jaw movements (B). Refer to Figure 3-31A and B.

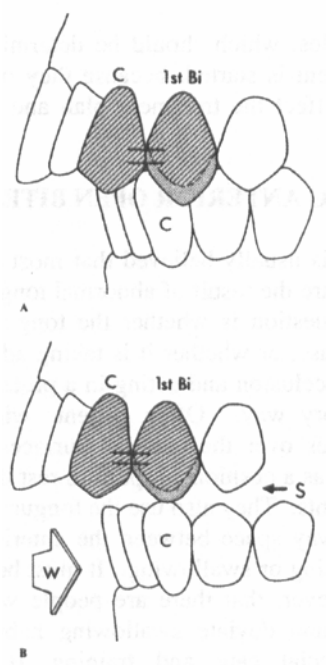


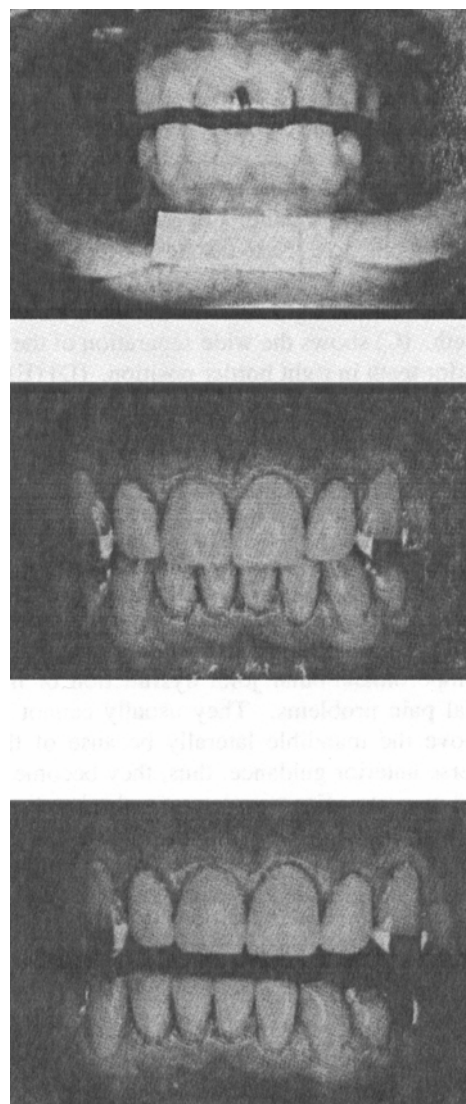
Figure 3-33 (A) Severe Class II canine situations can sometimes be solved by removing the lingual cusp on the upper first premolar and splinting the premolar to the canine with crowns. (B) When the mandible moves to the working side (W), the maxillary first premolar acts as the canine to create maximum spacing (S) between the posterior teeth on both sides. The recon-toured first premolar should not be made longer than the canine beside it.



Figure 3-34 Because of a “wedging” action of the anterior teeth in some severe Class II, Division 2 patients, and the continual tendency of the teeth and associated alveolar bone to migrate incisally, there is a tendency for the condyles to be displaced inferior and posterior from centric position.

of muscle or temporomandibular joint problems or mobile teeth. Obviously, this patient learned new chewing patterns which may have been responsible for the loss of his bruxism. Giving patients with worn-down teeth normal-length teeth with good overlap does not create problems with the muscles but causes the neuromuscular mechanism to respond favorably.

The patient must understand the problems and the treatment plan for him to relearn a more vertical type of chewing. The temporomandibular joint must be in a stable healthy condition and centric position contacts must be established on all teeth including the anterior teeth. The patient should be given an ideal anterior tooth overlap within the limits of normal unworn tooth length and good esthetics.



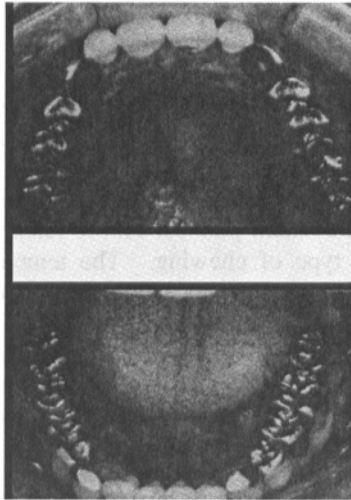


Figure 3-35 (A) Severely worn dentition on a 50-year old man was restored to a new vertical dimension of occlusion in 1967. (B) shows the restored dentition after 11 years in the mouth in centric position. Note the steep overlap of the anterior teeth. The gold on the canines readily indicates the length that was added to the worn teeth. (C) shows the wide separation of the posterior teeth in right border position. (D) (E) show unworn posterior restoration after 11 years due to the vertical guidance provided by the anterior teeth.

CLASS III PATIENTS

The Class III (mandibular prognathic) patients present a challenging group. It is interesting to note that few of these patients develop temporomandibular joint dysfunction or myofascial pain problems. They usually cannot easily move the mandible laterally because of the reverse anterior guidance; thus, they become vertical chewers. For muscle rest and relaxation during nonchewing time, the mandible is allowed to hang freely and the condyles can move freely to centric position. If the prognathism is severe, it is probably best to consider surgery followed by equilibration and restorative dentistry. However, if the case is not severe and the anterior teeth come end to end when the condyles are in centric position, orthodontics should be considered with an alternate back-up plan using restorative measures. These patients often have rather flat emmental angles, which should be determined before treatment is started, because they may significantly affect the treatment plan and its success.

TREATING ANTERIOR OPEN BITES

It is usually believed that most anterior open bites are the result of abnormal tongue habits. The question is whether the tongue is the primary cause, or whether it is taking advantage of the malocclusion and acting in a protective or compensatory way. Often patients will place their tongues over the occlusal surfaces of the teeth to act as a cushion or splint to rest the muscles and joints. They also use the tongue to close off the airway space between the anterior teeth when speaking or swallowing. It must be recognized, however, that there are people with true anomalies and deviate swallowing habits who require special care and training. (Garliner, 1971³⁵).

In any event, the anterior teeth of these patients should be placed in the same good relationship as those of other patients. Orthodontics should always be considered in treating these patients; however, sometimes the overlap of the teeth cannot be adequately established without a multidisciplinary approach involving orthodontics and restorative dentistry and even surgery at times.

Figure 3-36 shows a 60-year old female with temporomandibular joint dysfunction and myofascial pain who did not respond to myofunctional therapy. The patient was not amenable to orthodontic treatment. The anterior open bite was corrected solely with restorative measures since the vertical dimension of occlusion could not be reduced due to the relationship of the posterior teeth. Adequate anterior proprioceptive guidance was established with crowns of proper length, which restored harmonious muscle activity for normal function and at the same time produced a pleasing esthetic result. The patient has maintained centric position contacts with the anterior teeth for more than five years, and has had no recurrence of the temporomandibular dysfunction and myofascial pain.

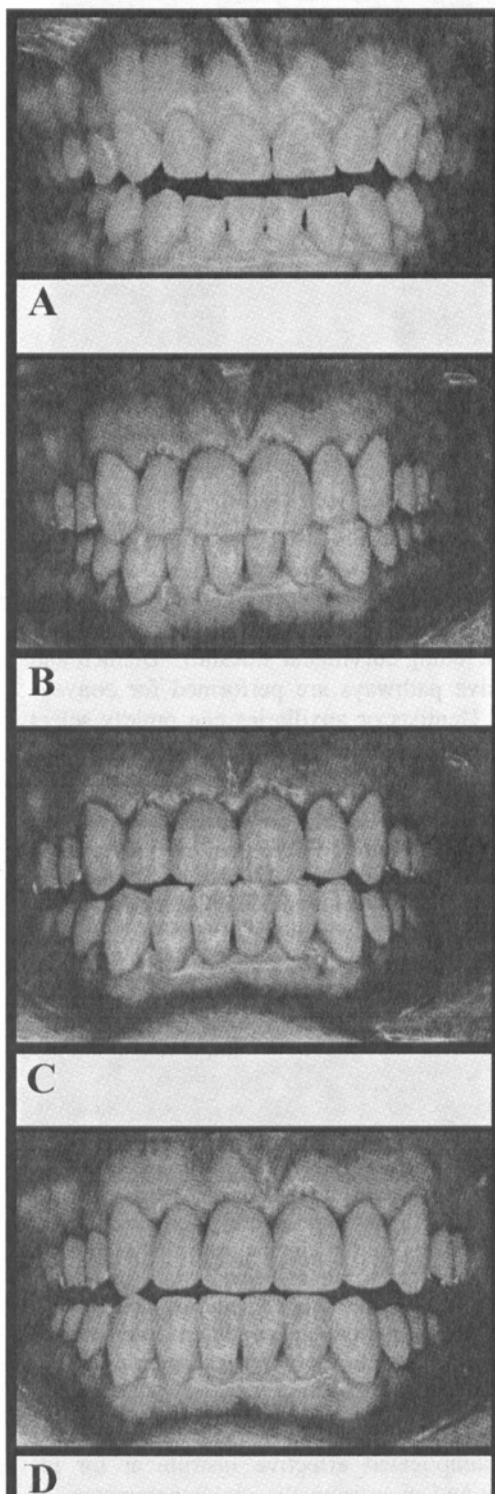


Figure 3-36 A 60-year old female patient with a severe open bite and temporomandibular joint dysfunction and myofascial pain. The patient had been treated unsuccessfully with myofunctional therapy. She was not amenable to orthodontic treatment. (A) shows the teeth in centric occlusion. there was a severe reverse curve of Spee as well as extensive wear on the anterior teeth. Because of posterior tooth relationships it was not feasible to reduce the vertical dimension of occlusion. The case was treated with restorative measures only, which restored anterior guidance as well as esthetics and eliminated the temporomandibular joint pain dysfunction. (B) shows the overlap of the anterior teeth in centric position. Figure (C) shows the protrusive incisive position. (D) illustrates the right border position and (E) the left border position showing the separation of the posterior teeth.

RATIONALE FOR ARTICULATORS

It might be thought that if anterior teeth are to be long and steep for everyone, then there may be no need for articulators that simulate patients' individual jaw motions. This logic might have merit except that in many cases dentists are called upon to treat a patient who may not be able to undergo orthodontia or orthognathic surgery. There may be no feasible way to get the anterior teeth into a good relationship for ideal guidance. Therefore, the practitioner may be forced to adapt the treatment plan and use an alternate, such as working-side group function. These group-function types of occlusal treatments demand closer simulation of the patient's individual jaw movements (Hobo, Shillingburg and Whitsett, 1976³⁶). It should also be recognized that anterior restorations of gold or porcelain or even enamel may wear over the years, and the cusps of the opposing posterior teeth may move closer together in eccentric motions. It is reasonable to use instruments properly ad-

justed to simulate the important functional movements of the mandible* (Figure 3-37A, B, C). With properly adjusted instruments it is possible to build a second line of control (Group function) into the posterior teeth. Working-side group function is the only feasible choice when the anterior teeth do not have good relationships. Group function can be used as an alternate plan for anterior teeth or crowns that may eventually wear.

Lundeen, Shryock, and Gibbs (1978)²⁷ have shown in some patients with fairly good cuspid relations that the lower posterior teeth sometimes approached the upper teeth from a rather horizontal angle, because of horizontal movements of the condyles before reaching centric position (side shift) or excessive axial inclinations of the posterior teeth. This also can be caused by a steep occlusal plane which has the effect of flat condylar paths.

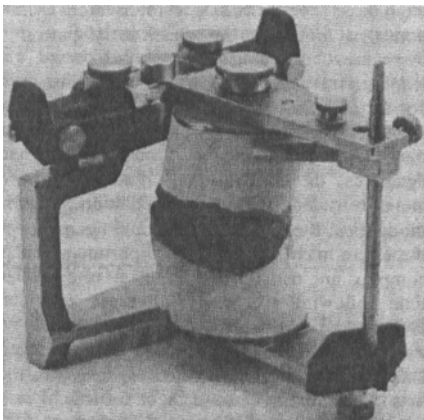


Figure 3-37A The Panadent Analog Articulator utilizes preformed analogs of condylar axis motion. The instrument was designed for use in orthodontics and removable prosthodontics as well as for fixed prosthodontics.

- Panadent Corp., 22575 Barton Road, Colton, CA 92324

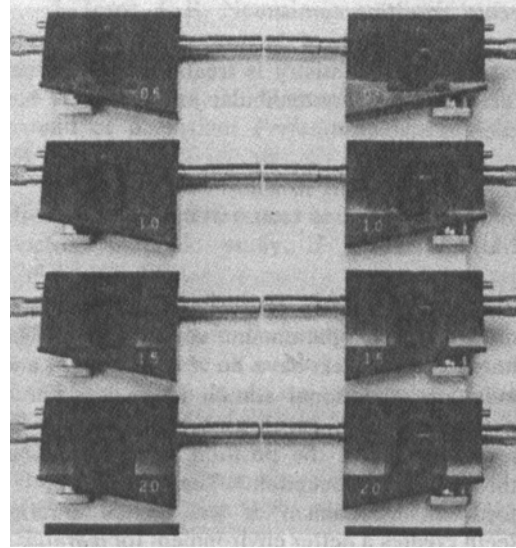


Figure 3-37B A series of statistically generated three-dimensional analogs of condylar axis motion, including curvilinear sideshift. Bennett and protrusive pathways are performed for convenience. Dentists or auxiliaries can rapidly select the matching analogs (articulator guides) for simulating a patient's condylar motions. The motion analogs are available in five sizes with varying amounts of immediate sideshift (0.5, 1.0, 1.5, 2.0, 2.5mm). They can be rotated individually to duplicate the slope of the patient's protrusive pathway. The analogs can also be mixed so that the right and left sides may have different amounts of sideshift.

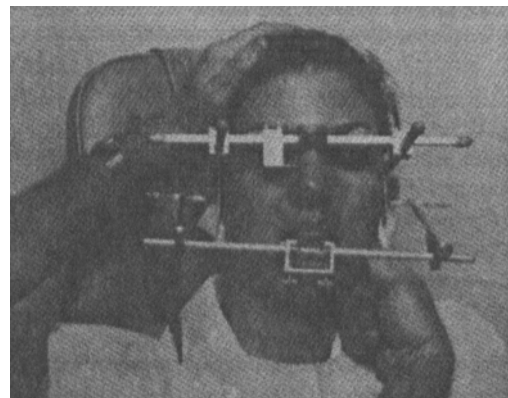


Figure 3-37C The Panadent Quick Analyzer is an uncomplicated effective instrument for recording and measuring the major parameters of condylar motion including: 1) protrusive pathways; 2) border pathways; and 3) immediate sideshift. The Quick Analyzer is used to select and adjust preformed analogs of condylar motion for the articulator.

Articulators are somewhat lacking in that they do not have a central nervous system, muscles, nerves, or ligaments. They do not show mobility of teeth and have no ability to learn. The primary functions of an articulator are:

1. Diagnosis and treatment planning
2. Communication of as much static and dynamic information about the patient as possible to the laboratory, so that dental restorations or appliances can be fabricated to meet the requirements with minimal adjustments in the patient's mouth.

To derive the maximum benefits, intelligent operators will understand and appreciate the limitations of articulators and know that they must incorporate a knowledge of biology of the masticatory system into the use of an articulator.

PATIENT EDUCATION

It is important to explain to the patient what his occlusion problems are, and how the jaws and teeth should function. The use of a Boley gauge to measure the patient's teeth, while the patient watches in a mirror, is a visual aid. Also, measuring and comparing the lengths of the patient's teeth to those of one of the office staff who has good anterior teeth is often effective. The use of colored pictures of patients with good front teeth or crowns, as well as models of teeth which show proper tooth length and relationships, are helpful. Patients should understand what good esthetics are and that good function is compatible with good esthetics.

Another important area deals with what the patients can do themselves to help rehabilitate their neuromusculature. They can make a conscious effort to practice a more vertical type of chewing rather than horizontal chewing. They should also be aware of the types of food they eat, which may cause undue stress on the masticatory system. An often effective analogy is to tell the patient that the temporomandibular joint ligaments, tendons, and muscles have been damaged similarly to an injured back, knee or elbow, which often takes many months or even years to heal. With the loss of the periodontal tissues, there is also a loss of periodontal pressoreceptors as well as mobility of the teeth. If the tooth support has been weakened by periodontal disease, there will always be a potential danger of over-

loading the teeth, and such foods as raw carrots, hard apples, or tough breads should be avoided.

The patient should be told that training splints and temporary crowns are a part of the rehabilitative learning process, that the learning time is not always instantaneous, and that it is not always the same for all people. Patients should be informed that it is normal for the lower jaw to hang freely and have little freeway space between the teeth when they are not chewing or swallowing. They should also make a conscious effort not to clench or grind the teeth.

MAINTENANCE

Many patients have been suffering from a malocclusion since childhood. Even though the teeth have been moved or restored into a condition that improves the masticatory patterns, there may be a long convalescent period extending over several years whereby the temporomandibular joint complex is undergoing change. For example, in patients with a large overjet who have developed loose or stretched ligaments, the condyles may gradually seek a more retruded or superior position. In orthodontics, the bones, sutures, and ligaments of the entire maxillofacial and temporomandibular complex are usually disturbed. It often takes time following treatment for these potential forces to be dissipated and become stable.

Dentists should recall these patients regularly after occlusal treatment, especially in the first two or three years, to check for loss of centric position contact between the anterior teeth. A good method for checking centric position is the Dawson technique which supports the mandible bilaterally and checks if the patient is able to hold 0.0005 inch mylar marking ribbon between the front teeth. If there is loss of anterior centric contact, the posterior teeth or crowns should be adjusted to bring the anterior teeth back into centric position contact.

Probably one of the most common errors in rehabilitative dentistry is treating the teeth before the temporomandibular joint complex has become stable.

SUMMARY

In any scheme of occlusion, the muscles must be given paramount consideration. The muscles, however, have no ability to learn and must get directional stimuli from the central nervous system, which gathers and stores information about the position of the mandible

through proprioception. The proprioceptive feedback mechanism of well-related anterior teeth creates a better environment for *learning* a more vertical and lasting masticatory pattern. Good anterior guidance reduces bruxism.

Achieving successful long-range rehabilitations of the masticatory system includes more than fabricating posterior occlusal surfaces in gold or porcelain on fully adjustable articulators. True rehabilitations also involve conscious and subconscious *learning* through proprioceptive inputs from the position and morphology of the teeth as they relate to each other, as well as how the teeth relate to the mucosa, lips, cheeks, and tongue. The role of the anterior teeth in achieving more predictable and lasting success in occlusal treatment, such as maintaining centric position and harmonious muscle activity is essential.

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